

of new Claims 4 and 5. New independent Claim 4 reflects the limitations of previous independent Claim 1. New independent Claim 5 reflects the limitations of previous independent Claim 3. The limitations of previous Claim 2, being functional recitations, have been deleted herein.

Importantly, the new independent claims positively recite the "0.010 - 0.017 weight percent of barium". Applicant respectfully contends that this component of the composition of the present invention is neither shown nor suggested in the prior art Prengaman patent. In fact, the addition of such an amount of barium in the composition of the present invention achieves new and unexpected benefits over that of the positive grids of other lead alloy batteries and, in fact, offers a synergistic benefit.

The benefits of this percentage of barium were recited in the original specification in several respects. On page 7, penultimate line through page 8, line 4, it is stated that:

Increased strength is attributable to the presence of barium atoms which lead the formation of different precipitates that block the crystals growing during solidification. On the other hand, batteries made according to the present invention suffer less degradation over the useful life of a battery in comparison to the degradation experienced by batteries using positive grids manufactured from Pb-Ca-Sn-Al-Ba alloys with no silver.

On page 9, line 15 - 18, the percentage range of barium contribution has been proven in the present application to allow adequate mechanical properties while eliminating high temperature age hardening. This process was described as follows:

The barium content of this lead based alloy should be maintained in the range of 0.0100 to 0.0170 wt %. This range has been found, in conjunction with a calcium content of about 0.05-0.07 wt %, to allow adequate mechanical properties while lowering the rate of lead matrix recrystallization and eliminating the high temperature age hardening required for lead-silver alloys.

On page 11, the importance of the composition using barium was recited on line 18 through line 23 as follows:

So, from Fig. 1 we can conclude that grids made from the Pb-Ca-Sn-Al-Ba and Pb-Ca-Sn-Al-Ag-Ba alloys, according to the present invention became harder sooner than those made from conventional Pb-Ca-Sn-Al-Ag. One important finding from these results is that the grids made with alloys according to the present invention do not require age hardening at temperatures higher than the room temperature as is usually required for conventional Pb-Ca-Sn-Al-Ag alloys.

Additionally, and furthermore, the barium has a synergistic aspect with respect to its addition to the silver in the positive grids. This synergistic benefit was described on page 14, lines 15 - 20, as follows:

The data of the previously described tests supports the view that batteries made with positive grids using the alloy of the present invention have improved hardening performance with respect to the silver without barium alloy, and improved corrosion performance with respect to the barium without silver alloy. The invented alloy delivers the rest of the two performance parameters making possible not only to achieve better manufacturability for automobile batteries through a faster hardening alloy, but also to produce a battery which suffers less degradation over its useful life.

As such, it can be seen that the present invention achieves new and unexpected benefits through the formation of the composition with 0.010 through 0.017 weight percent of barium in the composition. The amount of the barium is important, as a component of the alloy, so as to achieve these new and unexpected benefits. The illustrations of FIGURES 1 - 3 associated with the original specification demonstrate empirically the benefits associated with the barium-added composition of the present invention.

The Prengaman patent does suggest the use of barium in a passing reference. Applicant's

attorney can find the only reference to the use of barium in the Prengaman patent application in paragraph 29 as follows:

The battery grid may contain 0.005 to 0.05% copper in place of some of the silver, provided that the silver level is always at least 0.005% and that no more than a trace of aluminum is present. The battery grid may also contain trace amounts of many materials, such as sulfur, nickel, antimony and arsenic. "Trace amounts" typically refers to amounts below 0.001%. The grid may also contain small amounts of other impurities, such as bismuth, found in recycled lead. Strontium or barium in amounts not exceeding 0.05% may also be present.

This passing reference to the use of barium in the composition of the Prengaman publication would, in no way, describe the weight percent of the present invention. There is no suggestion of the weight percent of between 0.010 and 0.017 weight percent in the Prengaman publication. Additionally, there is no suggestion as to the benefits associated with such barium in the formation of the positive grids of the lead-acid battery. The Prengaman patent lacks any reference to the new and unexpected benefits of the present invention, associated with this barium addition. Although there is a technical reference to barium in quantities of less than 0.05 percent, Applicant respectfully contends that one having ordinary skill in the art would not deduce from the Prengaman reference that barium in an amount of between 0.010 and 0.017 weight percent would achieve the numerous benefits of the present invention. In the Prengaman patent, the appearance of barium appears more as a nuisance or a derivative byproduct of the lead, rather than as an intentional addition for improving the quality of the positive grid. The empirical evidence of the improvements caused by the addition of barium in the amount specified in the present application is neither duplicated nor suggested in the Prengaman patent. On this basis, Applicant respectfully contends that the present invention, as defined by barium content of the composition, is nonobvious in view of the prior art Prengaman

publication.


Prengaman publication extensively describes the impact of the substitution of copper in place of the silver material. When copper is substituted for silver material in the Prengaman patent, the aluminum content must be a trace amount (i.e. less than 0.001%). In the present invention, the silver is an absolute requirement in combination with the specified barium composition. If copper were used in place of silver in the present application, the benefits of the present invention would not be achieved. As such, Applicant respectfully contends that the Prengaman patent actually teaches away from the composition of the present invention.

Based upon the foregoing analysis, Applicant contends that independent Claims 4 and 5 are now in proper condition for allowance. Reconsideration of the rejections and allowance of the present claims at an early date is earnestly solicited. Since no new claims have been added above those originally paid for, no additional fee is required.

Respectfully submitted,

Date

3.12.03

  
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John S. Egbert  
Reg. No. 30,627  
Attorney for Applicant

Harrison & Egbert  
412 Main Street, 7<sup>th</sup> Floor  
Houston, Texas 77002  
(713)224-8080  
(713)223-4873 (Fax)



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT: VAZQUEZ DEL MERCADO, Luis, Francisco; SILVA-GALVAN, Luis David

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EXAMINER: WILLS, M.M..

TITLE: SILVER-BARIUM LEAD ALLOY FOR LEAD-ACID BATTERY GRIDS

CERTIFICATE OF MAILING UNDER 37 CFR 1.8(a)

Assistant Commissioner for Patents  
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Respectfully submitted,

3.12.03  
Date

  
John S. Egbert  
Reg. No. 30,627  
Attorney for Applicant

Harrison & Egbert  
412 Main Street, 7<sup>th</sup> Floor  
Houston, Texas 77002  
(713)224-8080  
(713)223-4873 (Fax)

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